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Jurnal  
Pensil

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Journal homepage: <http://journal.unj.ac.id/unj/index.php/jpensil/index>

## COMPARATIVE STUDY OF RIGID PAVEMENT PLANNING USING BINA MARGA 2017 AND AASHTO 1993 METHODS

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### Abstract

This study was conducted to determine what factors influence the differences in the results of the Bina Marga 2017 method and the AASHTO 1993 method and determine which planning results are more efficient to be applied to Letjen S. Parman Street. The research method used is a comparative method, using the existing data and the latest data from surveys. As a result of analyzing a rigid road plan with a planned age of 40 years, the Bina Marga 2017 method obtained a concrete slab with a thickness of 305 mm, and the AASHTO 1993 method obtained a concrete slab with a thickness of 280 mm. Further differences in results can be seen in the level of traffic load during the service life, the diameter of the dowels, the spacing of the tie bars, and the minimum design height of the subgrade embankment. The differences in the results of these plans are caused by two main factors, namely the factor of using the cumulative traffic growth value (R) in the Bina Marga 2017 method and the direct use of the subgrade CBR value in the AASHTO 1993 method. Based on the data that has been obtained, it is concluded that the 1993 AASHTO method provides more efficient results to be applied with considerations in terms of smaller plate dimensions and fewer connections and reinforcement requirements. Which when calculating the work cost, the AASHTO 1993 methods results give a smaller number of work volumes, so it has the possibility to provide a more economical work cost than the Bina Marga 2017 methods results.

**Keywords:** Rigid Pavement, Bina Marga 2017 Method, AASHTO 1993 Method

P-ISSN: [2301-8437](https://doi.org/10.21009/jpensil.v11i1.24199)  
E-ISSN: [2623-1085](https://doi.org/10.21009/jpensil.v11i1.24199)

#### ARTICLE HISTORY

Accepted:  
30 November 2021

Revision:  
23 Januari 2022

Published:  
30 Januari 2022

#### ARTICLE DOI:

[10.21009/jpensil.v11i1.24199](https://doi.org/10.21009/jpensil.v11i1.24199)



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**Introduction**

Jalan Letjen S. Parman is a collector road that connects Pabuaran District with Ciledug District, Cirebon Regency. This road is grouped into the status of a district road, a 2-lane - 2-way road with a width of 7.00 meters and a length of 2050 meters. This existing road is in the form of flexible pavement which uses asphalt as the surface layer and granular material as the layer underneath. Worldwide, flexible pavement is also the most preferred pavement structure for constructing highways (Gautam et al., 2018).

Pavement is a major asset of road infrastructure (Shah et al., 2013). Traffic on the pavement is characterized by many different types of vehicles (Pais et al., 2013). Every day, this road is traversed by large vehicles such as trucks that supply market goods, trucks transporting sand, intercity-interprovincial buses (AKAP), trucks transporting agricultural products, and other large-loaded vehicles. Jalan Letjen S. Parman is also one of the access roads to the Ciledug Toll Gate KM 233, part of the Kanci-Pejagan Toll Road network and is one of the main roads routes to the Brebes Regency area, Central Java. According to the (Kabupaten Cirebon, 2009), the Ciledug Sub-district area has become the main economic centre in the eastern part of the Cirebon Regency. In the future, this area is planned to become part of the Cirebon Integrated Industrial Estate (KITC) for medium and large scale industries.

Pavement Condition Index (PCI) is an index of pavement conditions used to assess the pavement surface condition (Baladi et al., 1991). According to (Karim et al., 2016) the Pavement Condition Index (PCI) is a simple, easy and inexpensive way to monitor road surface conditions, identify maintenance and rehabilitation needs and ensure that road maintenance budgets are spent wisely.

Based on the road damage identification survey using the Pavement Condition Index (PCI) method on the Jalan Letjen S. Parman section, which was conducted from March 2021 to April 2021, Jalan Letjen S. Parman was identified as having damaged road structures. Asphalt pavement can experience fatigue cracking, reflective cracking, shrinkage cracking due to low temperature, transverse cracking, and so on (H.-P. Wang et al., 2021). On Jalan Letjen S. Parman there are potholes, crocodile cracks, curly cracks, damaged patches, box cracks, edge cracks, hollows, sungkurs, and sinks.

The average value of the sample on one PCI unit of the road is the PCI value of the road under review. The PCI value of each segment is the average value of each unit surveyed (Setyawan et al., 2015). From the survey, it was obtained that the final PCI value of Jalan Letjen S. Parman was 36.80, or in other words, the road segment was in the category of poor condition. The percentage of damage that occurs along the road is 21.07%; this value exceeds the safe limit of 15% road damage. This damage requires treatment in the form of rehabilitation or overall road improvement (Umum, 1995)

Table 1. Existing Road Condition Survey Results

No	Type of Damage	Code	Total Damage Area (m <sup>2</sup> )	Road Surface Area (m <sup>2</sup> )	Percentage of Damage to Road Section (%)
1.	Groove	15	27,00	14350,00	0,19%
2.	Amblas	6	53,69		0,37%
3.	Basin	4	24,15		0,17%
4.	Overweight	2	2,00		0,01%
5.	Keriring	5	390,59		2,72%
6.	Hole	13	691,94		4,82%
7.	Edge Way Down	9	15,90		0,11%
8.	Cracked	1	1040,41		7,25%

	Crocodile Skin				
9.	Cracked Box	3	490,90		3,42%
10.	Cracked Edge	7	78,82		0,55%
11.	Sungkur	16	19,30		0,13%
12.	Patches	11	188,80		1,32%
			3023,50	14350,00	21,07%

Further review the efforts to repair damaged roads that the District Bina Marga Office has carried out in Cirebon for the last five years, namely by patching holes, overlays, fog seals, and chip seals carried out three times a year. The overlay protects the pavement structure, reducing the rate of pavement damage and extending the pavement's service life (Zhang et al., 2010). A fog seal is the application of a dilute asphalt emulsion directly over a non-aggregated pavement. It aims to seal the pavement, prevent moisture infiltration, and enrich the hardened asphalt (Dong & Huang, 2015). At the same time, chip seal is the process of attaching a layer of aggregate to a layer of asphalt binder (Y. Wang et al., 2012).

However, these efforts did not provide optimal results, as evidenced by the time this research was carried out the roads suffered more widespread damage. Damage is exacerbated by surface drainage that is not functioning properly. This issue needs to be considered considering that poor drainage causes initial pavement damage, which causes structural road failure (Zumrawi, 2014). One of the causes of the drainage not going well is that the size of the existing surface channel does not meet the design requirements of the channel.

Drainage designs for highway facilities should strive to maintain compatibility and minimize interference with existing drainage patterns (Brown et al., 2001). On the drainage channel of Jalan Letjen S. Parman the width of the drainage cross-section (b) is smaller than the drainage depth (d). Referring to the (Umum, 2006), the design requirement of a rectangular drainage section is that the width of the channel must be twice the depth of the channel submerged in water. In other words, the existing drainage design does not take into account guard figures.

Several other factors that cause road damage are drainage blockages due to waste. Indiscriminate waste disposal also leads to negative impacts on life and the environment (Olukanni et al., 2014). Other causes are blockages due to sediment deposits, blocked water access to the canal due to concrete bridges/shopping paving, and damaged channel sections (landslides). This problem results in the disruption of draining water from the road. So that when it rains, the road is inundated with water, which further puddles can result in road damage and worsen the current level of damage (Sulistiyatno et al., 2012). According to (Ali et al., 2011) standing water is also the leading cause of the decrease in the durability of the coating.

From the problems that have been mentioned, the treatment in the form of replacing the type of pavement can be an option to cut off the potential damage to the road section (Marga, 1983). Therefore, the author proposes replacing the existing pavement type with a concrete slab structure or rigid pavement. Quoted from (Pramudita, 2017), rigid pavement can withstand the load of the vehicle axle and spread it to the subgrade efficiently, reduce non-uniform soil deformation, and last longer than flexible pavement because its structure can be planned up to its age 40 years of use. The advantages of rigid pavement are also long life, better ride surface visibility, less maintenance (Jain et al., 2013). From an economic perspective, assuming annual inflation and decline rates of 12% and 8%, respectively, rigid pavements become cheaper than flexible pavements after about nine years (Taunk, 1998).

The pavement planning method used in this research is the 1993 AASHTO method and the 2017 Highways Pavement Design Manual (MDP) method. The

AASHTO method is defined as the American Association of State Highway and Transportation Officials (Bausano & Williams, 2009). The 1993 AASHTO method was chosen because this method is a method that is widely used in road planning throughout the world, and the 2017 Bina Marga method is the latest road planning method published by the Directorate General of Highways, and this method has been adapted to the conditions of the Indonesian region. Quoted from (Almufid, 2020), the 1993 AASHTO method has characteristics in the rigid pavement planning process, namely, using the input parameters for the subgrade reaction modulus, reliability value serviceability value, and drainage coefficient. Typical input parameters of pavement planning for the 2017 Bina Marga method are regional VDF values and traffic load calculations for a certain period. The VDF value is the Vehicle Damage Factor for each type of vehicle (Wari et al., 2020).

The conclusions from the research of (Bakri, 2020; Maulana, 2019; Vinna et al., 2019; Yuliani et al., 2020; Zohri et al., 2019), stated that the 1993 AASHTO method gave stiffer pavement results that were thicker than the 2017 Bina Marga method. influenced by subgrade parameters or CBR values and traffic load figures during the design life. The CBR test is defined as a strength test widely used in flexible pavement design around the world (Attah et al., 2019). While the majority of the subgrade is flat and homogeneous (Gao et al., 2008).

Although the Bina Marga 2017 method is the reference for road pavement design in Indonesia at this time, as a method used in Indonesia for a long time, AASHTO does not necessarily provide worse planning results than the 2017 Bina Marga method. Analyze is to do a comparative study (Collier, 1993). Therefore, a comparative study was

conducted to determine what factors influence the differences in the results of the two planning methods and determine a more efficient planning result to be applied to the Jalan Letjen S. Parman section. One of the advantages of comparative studies is examining the intervention variables in individual cases to make inferences about possible causal mechanisms at work (Bennett, 2004).

This research also discusses the handling of subgrade conditions due to damage to existing roads, referencing General Specifications for Road and Bridge Construction Works, Directorate General of Highways in 2018, and re-planning road drainage channels according to rigid pavement designs referring to System Planning. Road Drainage, Ministry of Public Works, 2006.

Based on the background described, the purpose of this research is to find out what factors influence the differences in the results of the 2017 Bina Marga method planning and the 1993 AASHTO method, and to determine the more efficient planning results for applied to the Jalan Letjen S. Parman section. The other purpose of this research is as an insight for students who are studying Mechanical Earth Transfer. Where this course also discusses the planning, analysis and design of road construction (Mubarok et al., 2018).

## **Research Methods**

This research was conducted on Jalan Letjen S. Parman between Pabuaran and Ciledug sub-districts, Cirebon district, West Java province. The study was conducted at points STA 0+000 to STA 2+050 or approximately this road has a length of 2050 meters. Research time in June 2021 until completion.



Figure 2. Research Site Map



Figure 3. Conditions of Existing Roads

The scope of this research is as follows:

Table 4. Scope of Research

<b>Design life</b>	<b>40 Years</b>
<b>Type of rigid pavement</b>	Rigid Pavement Connected with Reinforcement (BBDT)
<b>Pavement Planning Method</b>	Bina Marga 2017 and AASHTO 1993
<b>Number of Lanes/Directions</b>	2/2 UD
<b>Planned Lane Width</b>	3500 mm
<b>Planning Subgrade Handling</b>	Yes (Reference General Specifications for Road and Bridge Construction Works, Directorate General of Highways in 2018)
<b>Road Drainage Planning</b>	Yes (Reference for Road Drainage System Planning, Ministry of Public Works 2006)
<b>Geometric Planning of Roads</b>	No
<b>Budget Planning</b>	No

Data collection techniques carried out include literature study and research data collection consisting of primary data (LHR data, existing road CBR data, and road technical data) and secondary data (CBR data for STA segment 0+450 – 0+ 900, rainfall data, and road elevation data). Where LHR is

the Average Daily Traffic or the average volume of two-way traffic that crosses a certain point in a day, usually measured throughout the year (Latifa & Prihutomo, 2019).

Planning analysis techniques in this study include rigid pavement planning using

the 2017 Bina Marga method and the 1993 AASHTO method, which consist of traffic load analysis, concrete slab thickness, road foundation structure, and design of connections and reinforcement. Then proceed with planning for special handling related to pavement type replacement, which consists of determining the minimum embankment height using the CESAL value resulting from each method, and planning for the use of micro piles. Micropile itself is defined as a foundation supporting element to withstand static and seismic loads (Sabatini et al., 2005). Next is road drainage re-planning, which includes calculating rain data, determining design discharge, and design of channel cross-section.

After all the technical analysis stages have been carried out, the next step is to conclude by comparing the results of the rigid pavement planning analysis using the 2017 Bina Marga method and the 1993 AASHTO method, by determining the more efficient planning results to be applied to the Jalan Letjen S. Parman section.

Suggestions will be put forward to provide direction if some things are lacking or other developments are needed in similar research.

**Research Results and Discussion**

The results of the traffic count survey referring to Pd. T-19-2004-B on Jalan Letjen S. Parman are as follows:

**Table 5. Traffic Count Survey Results**

Goal Vehicle	Group Type of Vehicle	LHR (Vehicle/Day)
2	Sedan, Jeep, Station Wagon	1845
3	Medium Passenger Transport	587
4	Pick Up, Micro Truck, and Delivery Car	496
5a	Small Bus	226
5b	Large Bus	197
6a	Light Truck 2 Axis	269
6b	Truck Medium 2 Axis	843
7a	Truck 3 Axis	64

Planning plan age is 40 years with segment CBR value of 6.12%, traffic growth rate factor (i) 3.50%, planned lane distribution factor (DL) 100%, planning direction distribution factor (DD) 0.50.

Based on the data above, the results of the analysis of rigid pavement planning using the Bina Marga 2017 method with the value

of the traffic load during the design life (CESA5) are 84050400,856 ESAL or 84.05+E06 ESAL. ESAL stands for Equivalent Single-Axle Loads or the sum of load equality factors for various shaft configurations (Smith & Diefenderfer, 2009). At the same time, CESAL is the cumulative value of ESAL.

**Table 6. Analysis of Traffic Loads During the Design Life of the 2017 Highways Method**

Type	Vehicle Type	LHR 2021	LHR 2023	LHR 2027	VDF5 Actual	VDF5 Normal	R (2023-2026)	R (2027-2063)	ESA5 (2023-2026)	ESA5 (2027-2063)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
2	Sedan, Jeep, Station Wagon	1845	1976	2192	0,00	0,00			0,00	0,00
3	Medium Passenger Transport	587	629	698	0,00	0,00	4,215	70,008	0,00	0,00
4	Pick Up, Micro Truck, and Delivery Car	496	532	590	0,00	0,00			0,00	0,00

5a	Small Bus	226	243	269	0,00	0,00	0,00	0,00
5b	Large Bus	197	211	234	1,00	1,00	162331,009	2989674,694
6a	Light Truck 2 Axis	269	289	320	0,50	0,50	111153,312	2044222,013
6b	Truck Medium 2 Axis	843	904	1002	9,20	5,10	6397507,735	65289895,817
7a	Truck 3 Axis	64	69	77	14,40	6,40	759412,476	6296203,800
<b>Total ESA5</b>							7430404,532	76619996,324
CESA5 (2023-2063)							84050400,856	(84,05+E06)

Table 7. Pavement Structure Determination Methods Type of Highways 2017

Design requirements for rigid pavement with joints and *dowels and tied shoulders*, with or without crack distribution reinforcement.

Pavement Structure	R1	R2	R3	R4	R5
Heavy vehicle axle group ( <i>overload</i> ) (10E6)	< 4,3	< 8,6	< 25,8	< 43	< 86
<i>Dowel</i> and <i>Shoulders</i>	Yes				
Pavement Structure (mm)					
Thickness of concrete slab	265	275	285	295	305
Foundation layer LMC	100				
Drainage layer (mm)	150				

Retrieved concrete slab 305 mm thick plan to the plate width of 10 m, using a coating thickness of 100 mm foundation LMC combined with aggregate foundation layer thickness of 150 mm. A transverse joint worn Øwith long stems 38-300450 mm, the

longitudinal joint is used D13-750 with stem length of 650 mm, the design of the transverse direction and longitudinal reinforcement used was Ø10-200. Where LMC stands for Latex Modified Concrete (Lee & Kim, 2018).

Table 8. Analisis Expenses Traffic Methods For Age Plan of Highways 2017

Gol.	Vehicle Type	LHR	VDF	DD	DL	Total days in one year	W <sub>18</sub> (ESAL)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2	Sedan, Jeep, Station Wagon	1845	0,0012	0,5	1	365	404,055
3	Medium Passenger Transport	587	0,2165	0,5	1	365	23210,037
4	Pick Up, Micro Truck, and Delivery Car	496	0,2458	0,5	1	365	22269,041
5a	Small Bus	226	0,2458	0,5	1	365	10138,021
5b	Large Bus	197	1,0413	0,5	1	365	37410,190
6a	Light Truck 2 Axis	269	2,9918	0,5	1	365	147030,942
6b	Truck Medium 2 Axis	843	2,9918	0,5	1	365	460514,952
7a	Truck 3 Axis	64	5,3443	0,5	1	365	62282,090
CESAL						(9)	763259,329

Table 9. Parameters for Input Analysis of Rigid Pavement Planning Method AASHTO 1993

No.	Parameter Input	Input Value
1.	Life	40 tahun
2.	CBR	6,12%
3.	Subgrade Reaction Modulus (k)	150 pci
4.	Initial Serviceability (P <sub>o</sub> )	4,5
5.	Terminal Serviceability (P <sub>t</sub> )	2,5
6.	Total Loss of Serviceability (ΔPSI)	2,0
7.	Reliability	85%
8.	Standard Deviation Normal (Z <sub>R</sub> )	-1,037
9.	Overall Standard Deviation (S <sub>o</sub> )	0,35
10.	Compressive Strength of Design Concrete (f <sub>c</sub> )	450 kg/cm <sup>3</sup>
11.	Modulus of Elasticity of Concrete (E <sub>c</sub> )	4560172,778 psi
12.	Flexural Strength of Concrete (S <sub>c</sub> )	600,023 psi
13.	Drainage Coefficient (C <sub>d</sub> )	1,175
14.	Load Distribution Coefficient (J)	2,8
15.	Traffic Volume during Design Life (W <sub>t</sub> )	64533788,261 ESAL

(3) Perhitungan tebal pelat beton dengan D = 11 inchi

$$\begin{aligned}
 & \text{Log}_{10}(64533788,261) \\
 & = -1,037 \times 0,35 + 7,35 \log_{10}(11 + 1) - 0,06 + \left\{ \frac{\text{Log}_{10} \left[ \frac{2}{4,5 - 1,5} \right]}{1 + \left[ \frac{1,624 \times 10^7}{(11 + 1)^{8,46}} \right]} \right\} \\
 & + (4,22 \\
 & - 0,32 \times 2,5) \times \left\{ \text{Log}_{10} \frac{600,023 \times 1,175 (11^{0,75} - 1,132)}{215,63 \times 2,8 \times \left[ 2,8^{0,75} \left( \frac{18,42}{\left[ \frac{4560172,778}{120} \right]^{0,25}} \right)} \right]} \right\} \\
 & 7,810 < 8,074 \text{ (memenuhi syarat)}
 \end{aligned}$$

Figure 10. Determination of the Estimated Thickness of Concrete Slabs Using the 1993 AASHTO Method Equation The1993 AASHTO

The results of the rigid pavement design with the traffic load value during the design life (W<sub>t</sub>) of 64533788,261 ESAL produces a concrete slab structure that meets the design requirements of 11 in (≈ 280 mm) thick. The plate length of 10 m, using a coating thickness of 100 mm foundation LMC combined with aggregate foundation layer thickness of 150 mm, a transverse joint that is used Ø32-300 with 450 mm rod length. The longitudinal joint is used D13-650 with stem length of 800 mm, design transverse direction and longitudinal reinforcement used was Ø10-200.

Special handling related to replacing the type of pavement structure on Jalan Letjen S. Parman STA 0+450 – 0+900 with a CBR segment of 3.20%. In this planning, the subgrade in that segment is assumed to have a soft soil layer due to hole damage and subsidence which causes puddles when it rains. This needs attention. Considering that when soil conditions are disturbed due to certain things that can reduce soil parameters' physical and mechanical properties, structural damage will occur and endanger human activities (Putri et al., 2020).

So the special handling planning analysis results using the value of the traffic load during the design life of the 2017 Bina

Marga method concludes that a thorough stripping of the subsoil is necessary. A soil fill with a minimum height of 1860 mm (CBR value from the embankment is 5.35%), a stabilization layer is required. cement with a thickness of 50 mm (stabilization CBR value

= 6.74% > 6.00% design requirements), and the application of micro pile in the form of a bamboo cone with a diameter of 80 mm, length of 200 cm, installation distance of 30 mm.

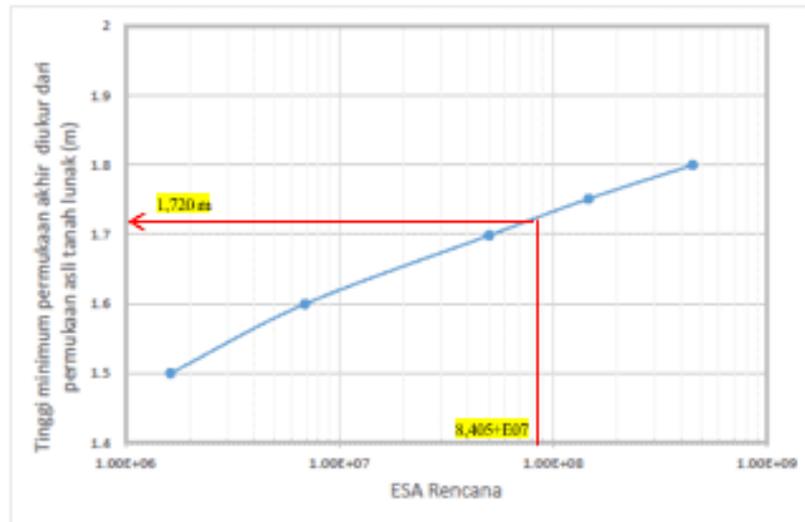


Figure 11. Determination of the Minimum Surface Surface Height of the Embankment using the Graphical Method

The results of the special handling analysis using traffic loads during the design life of the 1993 AASHTO method concluded that it was necessary to completely strip the subgrade and fill the soil with a minimum height of 1850 mm (CBR value of the embankment is 5.30 %). It also required a cement stabilization layer with a thickness of 50 mm (stabilization CBR value = 6.68% > design requirements of 6.00%), and the application of micropile in the form of a bamboo cone with a diameter of 80 mm,

length of 200 cm, installation distance of 30 mm. The results of the analysis of the handling of soft soils from the two results above by carrying out new embankment work and cement stabilization coatings give the final CBR value above the limit of the subgrade design requirements. So the use of a foundation layer in the form of a 100 mm thick LMC layer and a 150 mm thick aggregate foundation layer can be used on the Jalan Letjen S. Parman segment STA 0+450 – 0+900.

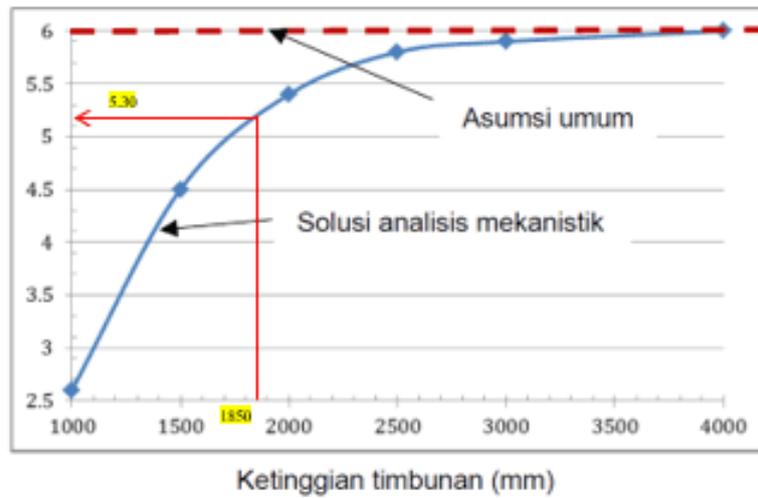


Figure 12. Determination of Effective CBR Value of Subgrade from Embankment

Re-planning of road drainage obtained from analysis of rainfall data for the last 10 years are as follows:

Table 13. Rainfall Data Analysis

Years	Average rainfall (mm) (Xi)	X	Deviation (Xi - X)	(Xi - X) <sup>2</sup>	Deviation Standard
(1)	(2)	(3)	(4)	(5)	(6)
2011	137,50		-75,608	5716,570	
2012	259,50		46,392	2152,218	
2013	264,80		51,692	2672,063	
2014	194,60		-18,508	342,546	
2015	248,20	213,108	35,092	1231,448	46,478
2016	160,68		-52,428	2748,695	
2017	224,40		11,292	127,509	
2018	239,10		25,992	675,584	
2019	148,00		-65,108	4239,052	
2020	254,30		41,192	1696,781	
<b>n = 10</b>	<b>ΣXi = 2131,08</b>			<b>Σ(Xi-X)<sup>2</sup> = 21602,466</b>	

Analysis of replanning drainage plan values obtained flow rate (Q) of  $0.0113 \text{ m}^3/\text{sec}$ , the need for cross-sectional area (Fd) of  $0.009 \text{ m}^2$ , the dimensions of the channel cross-section to a depth of 50 cm generates value  $b = 1,00 \text{ m}$ ,  $A = 0.50 \text{ m}^2$ ,  $R = 0.25 \text{ m}$ , guard height (W) 0.50 m, channel clearance slope ( $i_{\text{permit}}$ ) 1.29%. Channel slope control is carried out with conclusions in several segments. The channel requires the installation of a current breaker with an installation distance of 16 meters, the flow speed control in all channel segments is declared safe with a flow velocity value in the field ( $V_{\text{lap}}$ ) between the safe requirement values of  $0.16 \text{ m}^3/\text{second} < V_{\text{lap}} < 3.00 \text{ m}^3/\text{sec}$ . The design of a culvert with a diameter of 80 cm, a wet cross-sectional area of 64 cm, the slope of the channel ( $i_{\text{permit}}$ ) is 0.008 or 0.8%, with the slope control meeting the requirements of  $0.5\% < i_{\text{permit}} < 2.0\%$ . So that the difference resulting from this replanning lies in determining the depth and width of the design channel which is larger than the existing channel. So, the water capacity will be greater which is expected to be able to accommodate the water discharge on the Jalan Letjen S. Parman section which adjusts to the rigid pavement conditions in the future.

## Conclusions

The difference in the results obtained from the analysis of Bina Marga 2017 and AASHTO 1993's rigid pavement structure planning methods is more influenced by the design traffic load factor. Analysis of traffic load during the design life of 40 years with traffic growth of 3.50%, the results of the 2017 Highways method of 84050400,856 ESAL, while the results of the 1993 AASHTO method of 64533788,261 ESAL. The two results have a fairly large difference. This is because the traffic analysis of the 2017 Highways method takes into account the actual traffic load period and normal traffic with a different cumulative traffic growth factor (R) value for each period, so that from

the traffic calculations for the two periods, it produces a multiplayer load traffic value that is different. big. So that the large number of traffic loads results in a thicker coverage of the dimensions of the concrete slab and the need for more connections and reinforcement.

The 1993 AASHTO method considers the CBR value factor in determining the value of the subgrade reaction modulus (k), where the value of k affects the thickness of the concrete slab to be obtained. The smaller the CBR value, the smaller the k value, and the smaller the k value, the thicker the concrete slab dimensions. On the other hand, the Bina Marga 2017 method does not take into account the CBR value directly in the analysis process for determining the thickness of the concrete slab, so that the coverage of the thickness of the slab is obtained directly from the tabulation of the provisions for the thickness of the concrete plan slab.

From the two results of rigid pavement structure planning, the 1993 AASHTO method provides more efficient results to the Jalan Letjen S. Parman section, considering the smaller plate dimensions and the need for fewer connections and reinforcement. Where the time of the calculation of cost plans, the AASHTO method results in 1993 gives a figure of a smaller volume of work to have the possibility to provide a nominal cost of a job is more economical than the result of planning methods Highways, 2017.

## Suggestions

The advice is devoted to advanced studies or similar, be expected to deepen the analysis of the subgrade's bearing capacity to withstand the plan's traffic load by using more complex geotechnical data. And determine the best alternative for road foundation design in terms of material used, dimensions, construction methods, costs, and so on.

## References

- Ali, N., Tjaronge, M. W., Samang, L., & Ramli, M. I. (2011). Experimental study on effects of flood puddle to durability of asphaltic concrete containing refined Butonic asphalt. *Journal of the Eastern Asia Society for Transportation Studies*, 9, 1364–1375.
- Almufid, A. (2020). Perbandingan Perencanaan Tebal Perkerasan Kaku dengan Menggunakan Metode Bina Marga 04/Se/Db/2017 dan Metode AASHTO 1993. *Jurnal Teknik*, 9(2). <https://doi.org/10.31000/jt.v9i2.3076>
- Attah, I. C., Agunwamba, J. C., Etim, R. K., & Ogarekpe, N. M. (2019). Modelling and predicting of CBR values of lateritic soil treated with metakaolin for road material. *ARPN Journal of Engineering and Applied Science*, 14(20), 3609–3618.
- Bakri, M. D. (2020). Komparasi Desain Tebal Perkerasan Kaku menggunakan Manual Desain Perkerasan Jalan 2017 dan Metode AASHTO 1993. *Jurnal Borneo Saintek*, 3(2), 47–60.
- Baladi, G. Y., Novak, E. C., & Kuo, W.-H. (1991). Pavement condition index—remaining service life. In *Pavement management implementation*. ASTM International.
- Bausano, J., & Williams, R. C. (2009). Transitioning from AASHTO T283 to the simple performance test using moisture conditioning. *Journal of Materials in Civil Engineering*, 21(2), 73–82.
- Bennett, A. (2004). Case study methods: Design, use, and comparative advantages. *Models, Numbers, and Cases: Methods for Studying International Relations*, 19–55.
- Brown, S. A., Stein, S., & Warner, J. C. (2001). *Urban drainage design manual: hydraulic engineering circular 22*. United States. Federal Highway Administration. Office of Bridge Technology.
- Collier, D. (1993). The comparative method. *Political Science: The State of Discipline II*, Ada W. Finifter, Ed., *American Political Science Association*.
- Dong, Q., & Huang, B. (2015). Failure probability of resurfaced preventive maintenance treatments: Investigation into long-term pavement performance program. *Transportation Research Record*, 2481(1), 65–74.
- Gao, Z., Lenschow, D. H., Horton, R., Zhou, M., Wang, L., & Wen, J. (2008). Comparison of two soil temperature algorithms for a bare ground site on the Loess Plateau in China. *Journal of Geophysical Research: Atmospheres*, 113(D18).
- Gautam, P. K., Kalla, P., Jethoo, A. S., Agrawal, R., & Singh, H. (2018). Sustainable use of waste in flexible pavement: A review. *Construction and Building Materials*, 180, 239–253.
- Jain, S., Joshi, Y. P., & Goliya, S. S. (2013). Design of rigid and flexible pavements by various methods & their cost analysis of each method. *International Journal of Engineering Research and Applications*, 3(5), 119–123.
- Kabupaten Cirebon, P. (2009). *Rencana Pembangunan Jangka Panjang Daerah (RPJPD) Kabupaten Cirebon Tahun 2005-2025*.
- Karim, D. F., Rubasi, D. K. A. H., & Saleh, D. A. A. (2016). The road pavement condition index (PCI) evaluation and maintenance: a case study of Yemen. *Organization, Technology & Management in Construction: An International Journal*, 8(1), 1446–1455.
- Latifa, E. A., & Prihutomo, N. B. (2019). Analyzing deterioration on arterial roads caused by overloaded business vehicles. *Journal of Physics: Conference Series*, 1364(1), 12057.
- Lee, B. J., & Kim, Y. Y. (2018). Durability of latex modified concrete mixed with a shrinkage reducing agent for bridge deck pavement. *International Journal of Concrete Structures and Materials*, 12(1), 1–9.
- Marga, D. J. B. (1983). *Manual Pemeliharaan*

- Jalan No. 03/MN/B/1983. *Direktorat Jenderal Bina Marga*.
- Maulana, D. A. (2019). *Perencanaan Perkerasan Kaku dengan Metode Manual Desain Perkerasan Jalan 2017 dan Aashto 1993 di Jalan Alternatif Ajung–Rambipuji*.
- Mubarok, A. A., Arthur, R., & Handoyo, S. S. (2018). Pengembangan Pembelajaran E-Learning Mata Kuliah PTM/Jalan Raya Pendidikan Vokasional Konstruksi Bangunan Fakultas Teknik Universitas Negeri Jakarta. *Jurnal Pensil: Pendidikan Teknik Sipil*, 7(2), 87–94.
- Olukanni, D. O., Adebayo, R. A., & Tenebe, I. T. (2014). Assessment of urban drainage and sanitation challenges in Nigeria. *International Journal of Emerging Technology and Advanced Engineering*, 4(12), 100–105.
- Pais, J. C., Amorim, S. I. R., & Minhoto, M. J. C. (2013). Impact of traffic overload on road pavement performance. *Journal of Transportation Engineering*, 139(9), 873–879.
- Pramudita, D. A. (2017). *Perencanaan Tebal Perkerasan Kaku (Rigid Pavement) dengan Menggunakan Metode Bina Marga dan Rencana Anggaran Biaya pada Ruas Jalan Soekarno Hatta Balikpapan*. University of Muhammadiyah Malang.
- Putri, A. R., Sihombing, J., Iswandaru, Y. S., & Utama, W. (2020). Analisa Kuat Tekan Terhadap Variasi Beban Pemodelan Dinding Cantilever Menggunakan Sap 2000. *Jurnal Pensil: Pendidikan Teknik Sipil*, 9(2), 125–130.
- Sabatini, P. J., Armour, T., Groneck, P., Keeley, J. W., & Tanyu, B. (2005). *Micropile design and construction (reference manual for NHI Course 132078)*. United States. Department of Transportation. Federal Highway Administration.
- Setyawan, A., Nainggolan, J., & Budiarto, A. (2015). Predicting the remaining service life of road using pavement condition index. *Procedia Engineering*, 125, 417–423.
- Shah, Y. U., Jain, S. S., Tiwari, D., & Jain, M. K. (2013). Development of overall pavement condition index for urban road network. *Procedia-Social and Behavioral Sciences*, 104, 332–341.
- Smith, B. C., & Diefenderfer, B. K. (2009). *Development of truck equivalent single-axle load (ESAL) factors based on weigh-in-motion data for pavement design in Virginia*. Virginia Transportation Research Council.
- Sulistiyatno, A., Fajri, M. D., & Moctar, I. B. (2012). Pengaruh genangan air terhadap kerusakan jalan aspal dan perencanaan subdrain. *Jurnal Teknik POMITS*, 1(1).
- Taunk, G. S. (1998). Rigid pavement vs. flexible pavement. *Indian Highways*, 26(2).
- Umum, D. P. (1995). *Manual Pemeliharaan Rutin untuk Jalan Nasional dan Propinsi, Jilid II: Metode Perbaikan Standart*. Jakarta.
- Umum, D. P. (2006). *Perencanaan Sistem Drainase Jalan*. Surat Keputusan Menteri Pekerjaan Umum.
- Vinna, A. D., Prihutomo, N. B., & Pramono, E. (2019). Analisis Tebal Perkerasan Kaku Metode AASHTO 1993 dan Metode Bina Marga 2017 Serta Biaya Pelaksanaan (Studi Kasus Proyek Jalan Tol Cinere–Serpong Seksi 1). *Prosiding Seminar Nasional Teknik Sipil*, 1(1), 496–506.
- Wang, H.-P., Guo, Y.-X., Wu, M.-Y., Xiang, K., & Sun, S.-R. (2021). Review on structural damage rehabilitation and performance assessment of asphalt pavements. *Reviews on Advanced Materials Science*, 60(1), 438–449.
- Wang, Y., Wang, G., & Mastin, N. (2012). Costs and effectiveness of flexible pavement treatments: Experience and evidence. *Journal of Performance of Constructed Facilities*, 26(4), 516–525.
- Wari, W. N., Suryani, E., Ulfiyati, Y., & Syafa'at, I. W. (2020). Aged Reduction Prediction of the Road Plan Due to Overload On the Pancer Road, Pesanggaran District, Banyuwangi. *IOP Conference Series: Materials Science and Engineering*, 854(1), 12014.
- Yuliani, R. D., Subagyo, U., & Burhamtoro. (2020). Analisis Tebal Perkerasan

- Metode AASHTO (1993) dan Metode Bina Marga (2003) Studi Kasus Jalan Tol Semarang–Solo Sta 41+200–46+600. *Jurnal Online SKRIPSI Manajemen Rekayasa Konstruksi Politeknik Negeri Malang*, 1(2), 44–49.
- Zhang, H., Keoleian, G. A., Lepech, M. D., & Kendall, A. (2010). Life-cycle optimization of pavement overlay systems. *Journal of Infrastructure Systems*, 16(4), 310–322.
- Zohri, S., Sutrisno, W., & Priyanto, A. (2019). Analisis Tebal Perkerasan Kaku Pada Jalan Tol Pasuruan–Probolinggo Berdasarkan Metode Bina Marga (Manual Desain Perkerasan 2017) Dan AASHTO (1993). *RENOVASI: Rekayasa Dan Inovasi Teknik Sipil*, 4(1), 33–41.
- Zumrawi, M. M. E. (2014). The impacts of poor drainage on road performance in Khartoum. *Int. J. of Multidisciplinary and Scientific Emerging Research*, 3(1).